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Analysis of Costs of Production and Profitability for Irrigated Cotton under Smallholder Production Systems; the Case of Middle Awash Valley

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አህፅሮት

ቀጣይነት ያለዉ የግብዓት ዋጋ ጭማሪና የተጥ ምርት ዋጋ መዋዠቅ በአነስተኛ አምራቾች ዘንድ የጥጥ ምርትን ትርፋማነትና ዘለቄታዊነት ጥያቄ ዉስጥ እንዲወድቅ አድርጎታል። ይህ ጥናት በአነስተኛ አምራቾች ዘንድ በመስኖ ጥጥን ለማምረት የሚከናወኑ ተግባራትን ከትርፍ አንጻር ለመገምገም በመካከለኛዉ አዋሽ አሚባራ ወረዳ የተከናወነ ነበር። ጥናቱ 30 የሚሆኑ አነስተኛ የመስኖ ጥጥ አምራቾችን በአላማዊ ናሙና በመምረጥ የተካሄደ ሲሆን የመስኖ ጥጥ ምርት ወጪና ትርፍን ለመለካት የሚያስችሉ ገላጭና የቢጅት ቴክኒኮችን ለትንተና ተጠቅሟል። በተመሳሳይ ትርፍም ኪሳራም የሌለበትን የዋጋና የምርት መጠን እንዲሁም ሊያጋጥሙ የሚችሉ ለዉጦችንና ሲጋቶችን ግምት ዉስጥ በማስገባት ትንተና ተካሂዷል። ዉጤቱም እንደሚያሳየዉ የመስኖ ጥጥን ለማምረት ከሚወጡት ወጪዎች መካከል የሰዉ ጉልበት፣የኬሚካልና የማሽነሪ ወጪዎች ዋናዎቹ ሲሆኑ የባጅት ትንተናዉ ዉጤትም ጥጥ ማምረት በአነስተኛ አምራቾች ደረጃ ትርፋማ እንደሆነ አመላክቷል። በአነስተኛ አምራቾች ዘንድ ጥጥን በመስኖ ለማምረት የሚያስፈልገዉ የስራ ማስኬጃ ወጪ 20,572.17 ብር በሄክታር የነበረ ሲሆን በተመሳሳይ የተገኘዉ ትርፍ በሄክታር 10,294.23 ብር ነበር። በተጨማሪም የጥቅም-ወጪ ንጽጽር 1.49 ነበር። ትርፍ-ኪሳራ አልባ ዋጋና የምርት መጠን ደግሞ 8.35 ብር በ ኪ.ግ እና 1641.83 ኪ.ግ በሄክታር በቅድመ-ተከተል ነበር። ከዚህ በተጨማሪም ጥናቱ ከመስኖ ጥጥ የሚገኝ ትርፍ ከስራ ማስኬጃ ወጪዎች ይልቅ በምርትና በምርት ዋጋ መቀየር የበለጠ የሚጠቃ መሆኑን አሳይቷል። ስለሆነም የጥጥን ትርፋማነትና ምርታማነት ይበልጥ ለማስቀጠል የምርት ዋጋን ማረጋጋትና ምርትን ሊያሳድጉ የሚያስችሉ ግብዓቶችን በተመጣጣኝ ዋጋ ማቅረብ እንደሚገባ ጥናቱ ያመለክተ ሲሆን የተሳለጠ የግብዓትና ምርት ግብይት ይኖር ዘንድ ማህበራትን ማደራጀት ያስፈልጋል።

Abstract

The continuous increase of input costs and volatility of output prices have made the profitability and sustainability of smallholder cotton production in question. This study was carried out to examine the profitability of irrigated cotton production at Amibara district in the Middle Awash Valley under smallholder producers. 30 producers were purposively selected from the villages considered based on the predominance of irrigated cotton production. Primary data were collected for this study using well-structured questionnaires. Data were analyzed using descriptive statistics and budgetary technique analysis. Likewise, break-even and sensitivity analyses were introduced to determine the break-even price and yield and to account to any changes and risks envisaged. The break-up of production cost structure showed that operational (both manual and machinery) expenses were the prominent components of all variable costs. The principal findings of the enterprise budget analysis was that smallholder irrigated cotton production was a profitable enterprise with a gross margin of 10,294.23 Birr per hectare and a total expenditure of 20,572.17 Birr per hectare. Moreover, the benefit cost ratio of 1.49 was obtained. The break-even price and break-even yield at which the producers are at no loss no profit were 8.35 Birr per kg and 1641.83 kg per hectare. Returns from irrigated cotton were highly sensitive to fluctuations of price and yield than total variable cost. Thus, efforts should be made to improve productivity through provision of appropriate agricultural inputs at the lowest possible cost and reduce price volatility by promoting primary cooperatives at district level working on input output marketing.

Introduction

Cotton is a key raw material for the textile industry and represents about 30% of all fiber used in the sector (ICAC, 2017). Globally, around 30 million hectares are planted with cotton (ICAC, 2016), accounting for more than 2% of total arable land (FAOSTAT, 2017), and producing approximately 25 million metric tons (MT) of cotton annually. Grown in around 80 countries, more than 100 million households around the world are directly engaged in cotton cultivation (Fortucci P., 2002), relying on it for their income. Cotton, as a product, starts with seed cotton from the farmers and can be transformed into many products such as lint, yarn, fabric, and garments. It can also be used for edible oil, seed cake soap, and linters.

Cotton cultivation, processing, marketing and trading has been the main stay of tens of thousands in Ethiopia as it creates huge job opportunities at different value chains of the crop. It has a unique place in Ethiopian tradition with the linkage of handloom industry since the history of agriculture in the country. Cotton is an important source of cash for the growers, processors, exporters and producing countries. Cotton lint is an important input for the textile factories, garment manufacturing and cottage industries; the cottonseed for oil milling industries and the cottonseed cake for animal fattening. It is the sources of hard currency for the country through export of the lint and various products as well as by-products of the sub-sector.

The importance of cotton in Ethiopian agriculture can be described in terms of the vast suitable agro-ecologies available in the country and diverse farming systems produced by the small-scale farmers as well as the medium and large-scale commercial cotton farms. In Ethiopia the crop is grown in varied soils, climates and agricultural practices both under irrigated and rainfed conditions. Smallholder cotton production has been contributing at least 35% to total cotton production and satisfying the demand of the handloom industry and weavers whereas the remaining 65% of the cotton that are locally produced come from large enterprises both public & private (CPGEA, 2015 unpublished). Besides, 60% Ethiopian cotton is produced under irrigated conditions and the remaining 40% under rainfed situations (EIAR, 2017).

The Awash Valley, where the study was carried out, was used to be one of the main cotton growing areas in Ethiopia by producing over 64% of the total cotton production of the country in the recent past. Despite the congenial production and productivity situation prevailing in the Valley, cotton farms in this area are largely replaced by sugarcane plantation and other non-traditional crops that are economically and environmentally comparable to cotton.

On the other hand, the main outcries of cotton farmers in the study area are the increasing rate of input costs and volatile output prices. Which in turn have made the profitability and sustainability of smallholder cotton production in question. According to Allemann and Young (2008), crop production systems are dependent on the botanical characteristics, environment, climate, and land size, location, inputs used, as

well as other variables. Therefore, to attain optimal yield, natural resources, human capital, finances and agro-inputs must be combined in the most efficient way (Kibirige, 2013). One sure way of investigating the proper use of agro-inputs gainfully includes establishment of the profitability of the crop.

Cotton, being a commercial crop, requires careful and sensible decision in the investment process as it is capital-intensive enterprise. Farmers who are interested to go for this enterprise should be well aware with different types of monetary information like total cost of cultivation particularly about operational costs, gross and net returns they will get from this enterprise and what will be the benefit-cost ratio in this enterprise. However, farmers are generally confronted with problem of determining the profitability in cultivation of cotton. In this respect, this study was carried out to estimate the cost of production and profitability of cotton under irrigated condition among small-scale producers in the Middle Awash Valley of Ethiopia. Further, this study contributes to provide empirical evidences on the profitability of irrigated cotton production by identifying the cost structure, the break-even price and break-even yield as well as the responsiveness of the return.

Methodology

The study area

Amibara district was used for this study. The district is found in Gebiresu Zone, located in the Middle Awash Valley, of Afar Region. The district lies between latitude of 09°13 ′ and 09°30 ′ N and longitude of 40°05 ′ and 40°25 ′ E. It has a total land area of about 2007.05 km^2 and a home of 78,105 inhabitants of which 43,540 are male and 34,565 females with a population density of 38.9 km^{-2} (CSA, 2012). The altitude of the district ranges from 665 to 815 meter.

The climate is essentially that of arid to semi-arid, with maximum and minimum temperatures varying from 25 to 42°C and 15.2 to 23.5°C, respectively, and an average annual rainfall of 560 mm. The climate is generally characterized by alternating dry and wet seasons. May and June are the driest months, whereas July through September is the main rainy season.

The area was selected because of its representativeness of irrigated agriculture and is well known for cotton production in the country. A significant (more than 13%) proportion of cotton produced in the country comes from this area. The main ethnic groups in the area are the *Afars*. Agriculture (both livestock and crop production) is a main source livelihood and income to the population in Amibara district. The district is endowed with fertile soils capable of supporting a variety of crops including cotton, maize, onion, tomato, and others.

Sampling design and size

The sampling frame of the study was smallholder irrigated cotton producers. Purposive sampling technique was employed based on the available cotton producers to select sample respondents since the number of smallholder cotton producers was low. Data were obtained from 30 cotton farm households for assessing the seasonal cost of production of irrigated cotton under smallholder condition.

Data type and collection methods

Primary data was collected from producers using a pretested structured questionnaire with a face-to-face personal interview. The selected farmers were contacted, interviewed, and the required information was collected from them. Detailed information on all the variable production costs incurred from land preparation to harvesting as well as yield obtained were collected. Efforts were made to value purchased and non-purchased inputs, such as family labor. Market prices for inputs and yield were also collected. These data were used in the calculation of the net margins or profit (defined as the residual after variable production costs are deducted from the total revenue. Since marketing of seed cottonseed cotton in the study area took place at farm gate, only packing, weighing and loading costs were considered as marketing costs and included under manual operational costs. All costs and benefits were standardized to hectare level.

Data analysis

The data collected was subjected to descriptive statistics and budgeting techniques (Gross margin, break-even and sensitivity analysis). The descriptive statistics, like frequency and percentage was used to describe variables and their occurrences among respondents while, mean was used as a measure of central tendency. Percentages were also used to analyze the share (computed as a percentage of the total variable costs) of each cost item in the total variable costs. Gross margin analysis gives the difference between the gross incomes and variable cost. The gross margin is an appropriate measure of profitability used for comparing enterprises for short run annual planning decision. Data were pooled and analyzed as one sample because the number of observations (30 producers) could not support analysis of disaggregated data.

To determine the market value of seed cottonseed cotton, a gross margin analysis was conducted. Cross-sectional data on variable costs per hectare associated with production of seed cottonseed cotton and the revenue generated from the sale of the produce was used. Gross margin was used as a proxy for profitability of an enterprise. Kay *et al*., (2004) defined gross margin as the difference between income and variable costs.

Gross margin (GM) was evaluated by identifying and quantifying the Total Variable Costs (TVC) incurred by the farmers, and the Total Revenues (TR) realized in the production of irrigated cotton per season. The TR is estimated as the prevailing market price of a given output (P_y) multiplied by quantity of output sold (Q_{ys}) ($P_y * Q_{ys}$). Total variable costs is a summation of all input variable costs incurred by a given producer,

and the input variable cost is estimated as the prevailing market price of a given input (P_{xi}) multiplied by quantity of the input used (Q_{xi}) ($P_{xi} * Q_{xi}$). Thus,

$$TVC = \sum(P_{xi} * Q_{xi}) \quad (1)$$

$$GM = (\sum(P_y * Q_{ys})) - (\sum(P_{xi} * Q_{xi})) \quad (2)$$

Where GM is the gross margin, TVC is the total variable cost, P_{xi} is the price of input i, Q_{xi} is the quantity of input i, P_y is the price of output i and Q_{ys} is the quantity of output sold.

Break-even analysis was employed to determine the break-even yield and the break-even price at which the total receipt is equal to total costs. The break-even formulas are;

$$Break - even\ price = \frac{Total\ Costs}{Total\ Production\ (Yield)} \quad (3)$$

$$Break - even\ yield = \frac{Total\ Costs}{Sale\ Price} \quad (4)$$

The profit margin (PM) was calculated by dividing net revenue by total revenue and expressed in terms of percentage, while the benefit to cost ratio was computed by dividing total cost (TC) to total revenue (TR) as shown below;

$$\text{Profit Margin (PM)} = \frac{NR}{TR} * 100 \quad (5)$$

$$\text{Benefit Cost Ratio (BCR)} = \frac{TC}{TR} \quad (6)$$

A sensitivity analysis using the estimated economic values (costs and benefits) was undertaken to incorporate uncertainty into economic evaluation of irrigated cotton production. To assess the stability of profitability of irrigated cotton production, the total variable cost, the price of seed cottonseed cotton and the quantity produced were subject to reduce by 25% and to increase by the same amount and new gross margins was computed. The 25% variability was chosen due to different reasons. Firstly, as manual operational cost (labor cost) is the highest input cost in cotton production and the main sources of labor are other areas, particularly from Southern region (SNNPR), rise in labor wage is assumed. Secondly, chemical inputs are the other most expensive inputs as the crop is highly sensitive to different pests and insects. The prices of chemicals are rising from time to time as they are imported from abroad. Thirdly, as cotton is an industrial and commercial crop its production and marketing is more or less global in extent. As the result, cotton production is a speculative business if reliable production information is not available. On the other hand, the development of hybrid varieties and use of Bt. cotton technologies will assume to increase yield and reduce chemical application. Thus, the combinations of the above input and output changes were considered.

Results and Discussion

Socio-economic characteristics of respondents

The socio-economic characteristics of irrigated cotton growers in the study area are presented in Table 1. The table revealed that 63.33% of the growers were within the age group of 20-40 years, while above 50 years takes seven percent (7%) of the sampled respondents. The distribution showed that the majority (93%) of the respondents were within their active working ages.

The result of the study revealed in Table 1 that 90% of the respondents were males while the remaining 10% were females indicating that there are more males in irrigated cotton production than females. The table also showed the distribution of family size among the irrigated cotton farmers with the highest number of respondents belonged to those with family size of more than nine people, which represents 33.33% of the sampled respondents. The table also pointed out that 63.33% of the sampled respondents were married, while 23% were widowed and 10% were divorced. Only three percent (3%) of irrigated cotton farmers were single.

Table 1: Socio-economic characteristics of respondents (n=30)

Variable	Frequency	Percentage
Gender		
Male	27	90.00
Female	3	10.00
Age		
30-30 years	7	23.33
31-40 years	12	40.00
41-50 years	9	30.00
Above 50 years	2	6.67
Marital status		
Single	1	3.33
Married	19	63.33
Widowed	7	23.33
Divorced	3	10.00
Family size		
1-3 families	4	13.33
4-6 families	9	30.00
7-9 families	7	23.33
Above 9 families	10	33.33
Educational level		
Illiterate	16	53.33
Adult education	7	23.33
Primary education	3	10.00
Secondary education	4	13.33
Farm size		
0.25-1.00 hectare	12	40.00
1.01-2.50 hectares	11	36.66
Above 2.50 hectares	7	23.33

Source: Field survey data, 2016

From the Table, 23.33% of the respondents had formal education ranged from primary to secondary level. Of those who attend school, 10% had gone up to primary level, whilst 13% had attained secondary education. However, more than half (53%) had no any education at all while 23% of them had attended informal education (can read and write).

The result of the analysis in table 1 had it that 76.67% of the irrigated cotton growers had farm size ranged from 0.75-2.5 ha, while the remaining 23.33% had above 2.5 hectares. This implies that the majority of smallholder cotton grower in the study area was in need of capital access to expand their farm size.

Cost structure of irrigated cotton production

The major cost structure of irrigated cotton production can be generalized as material costs and operation costs. The material costs are those costs incurred for the purchase of seed, chemicals/pesticides and packing materials and others. Operational costs are those expenditures allotted to other farming activities. In the study area, farm operations are performed both by machineries and by human labors. Thus, there are machinery operation costs and manual operation costs.

Table 2 describes the expenditure on materials and operations (machinery and manual) incurred by farmers and percentage of these costs in total cost in the production of irrigated cotton per hectare. In the table (Table 2), the mean variable cost of each items, the standard deviation and the percentage share of each cost component to the total variable cost have been revealed.

Table 2: Break-up of cost of irrigated cotton cultivation per hectare

Particular	Mean (Birr)	SD (Birr)	% of total cost
Material cost			
Seed	626.2	150.224	3.04
Chemicals/pesticides (different types)	5,933.33	1771.34	28.84
Packing materials	136.11	17.964	.66
Machinery operation cost			
Plowing, disking and ridging together	3,602.04	211.343	17.51
Manual operation cost			
Slashing/land clearing	346.95	115.156	1.69
Planting/sowing	458.25	51.067	2.23
Weeding	1,100.00	240.689	5.35
Chemical spraying	974.99	148.684	4.74
Field irrigating	1,216.67	345.497	5.91
Picking/harvesting	2,956.1	625.84	14.37
Weighing and packing	120.98	15.968	.59
Other cost			
Rental value of land	3,100.56	203.111	15.07
Total average variable cost	**20,572.17**	**1,899.058**	100

Source: Field survey data, 2016

NB: Total Average Variable Cost = Material cost + Machinery operation cost + Manual operation cost + other cost.

It seems from Table 1 that the overall average variable cost of producing irrigated cotton was Birr 20,572.17 per hectare with a minimum of 17,433.5 and a maximum of 24,541 Birr per hectare. The share of material costs in the total cost of cultivation was 32.55 percent. While the share of machinery and manual operation costs in the total cost of cultivation was 17.51 and 34.87 percent, respectively. On the other hand, the rental value of land took 15.07 percent of the total variable cost in cultivation of irrigated cotton.

Among the components of various variable costs, operational expenditures (both machinery and manual operational expenses) together accounted for 52.38 percent of the total variable cost. Out of the operational costs, cost of plowing (including disking and ridging) occupied the first position with 17.14% (Birr 3602.04) followed by cost of picking/harvesting with 14.37% (Birr 2,956.1). This is a clear sign that most of irrigated cotton activities under smallholder producers are labor intensive and therefore, attracted more costs, which accounted for more than half of the average costs in cotton farms. Similarly, Odedokum *et al.*, (2015) came out with a similar result on their work in economic analysis of cotton production among cotton farmers in Northern Nigeria.

Costs of individual inputs

The costs that cotton producers incurred in the production process consist of material costs, labor costs and other costs as stated previously in the break-up of costs. These costs are incurred at various stages of the cotton cultivation practices during the planting period. The cultivation practice, including planting periods, for cotton in Ethiopia considerably varies from area to area depending mainly on climatic condition and producer-capacity.

Table 3 reports the cost of each individual inputs applied in the production of irrigated seed cottonseed cotton per hectare at Middle Awash Valley. Particulars of the production input types by their unit of measurement and costs of each input with minimum and maximum values per hectare are described (Table 3).

Table 3: Per hectare costs of irrigated cottonseed production by smallholders

Particular	Unit	Min.	Max.	Average cost (Birr)
Seed	kg	390.00	1,140.00	626.20
Chemicals/pesticide	l	3,500.00	10,000.00	5,933.33
Packing materials	Number	105.00	180.00	136.11
Plowing, disking, ridging	ha	3,200.00	4,165.38	3,602.04
Land clearing/slashing	Ha	150.00	550.00	346.95
Planting/sowing	man-day	400.00	600.00	458.25
Weeding	man-day	600.00	1,500.00	1,100.00
Chemical spraying	man-day	825.00	1,400.00	974.99
Field irrigating	man-day	600.00	2,000.00	1,216.67
Picking/harvesting	kg	2,160.00	4,560.00	2,956.10
Weighing and packing	kg	93.33	160.00	120.98
Rental value of land	ha	2,750.00	3,500.00	3,100.56
Total variable cost	Birr	17,113.00	25,074.33	20,572.17

Source: Field survey data, 2016

Cost of land preparation

In irrigated areas such as the Middle Awash Valley of Afar Region, land preparation starts by clearing the stalks of previous crop in January and ends mostly in April. Land preparation practices constitute land clearing, plowing, dicking, and ridging activities. The land clearing activity includes cutting/clearing the stalks of previous crop (mainly cotton stalks), collecting and burning of stalks.

Land clearing activity is done mainly by hand in the study area. Producers used hired human labor in clearing activity. This activity is performed with contractual agreements made between workers and producers on hectare basis. On average, the land clearing cost that producers incurred per hectare in the study area was Birr 346.95 (Table 3).

Plowing of cotton farm field begins in March and April, depending on the availability of plowing machines, in the study area. The plowing operation includes, tilling, disking and ridging. All these activities are done with tractors mounted farm implements as use of animal tracking is not used at all in the district. Smallholder producers used hired tractors to carry out the plowing operations. The rental values of tractors varied from activity to activity and ranged from 1,750.00 to 1,500.00 Birr/ha for first plowing, from 1,385.00 to 800.00 Birr/ha for disking and from 1,231.00 to 700.00 Birr/ha for ridging. The general average machinery operations cost of irrigated cotton cultivation—including plowing, disking, and ridging—was about 3,602.04 Birr/ha (Table 3).

Cost of capital inputs

The capital input costs included cost of cottonseed and cost of chemicals/pesticides used in the production of irrigated cotton under smallholders. The cost of irrigation water, and cost of fertilizers, was not included in this study. This is because the former cost is too small to consider for smallholders while the later cost component is almost nil, as smallholders in the study area apply no fertilizer of any type for the cotton crop, which is against the recommendation of 46 kg/ha of Urea (Arkebe G., *et al*., 2014).

Sample producers planted cottonseed bought from commercial farms. The cottonseed variety applied by cotton producers in the area is entirely Deltapine 90 (DP-90). The amount of seed applied per unit area differs according to the types of type of the cottonseed (being fuzzy or non-acid delinted and the acid delinted) and the planting methods (manual or mechanical). Accordingly, a seed rate of 30-45 kg/ha is recommended for non-acid delinted type while 15-20 kg/ha is recommended for the acid delinted type of seed (Arkebe G., *et al*., 2014). Most of the cotton farms in the study area use acid delinted type of seed bought from commercial farms. However, the seed rate they used vary considerably among producers (13-30kg/ha). The average cost of planting seed came to 34.00 Birr/kg that ranged from 28.00 to 38.00 Birr/kg. Consequently, the cost of seed ranged from 375.00 to 1,140.00 Birr/ha while the average seed cost was about 623.00 Birr/ha. The differences in seed cost shows the differences for rate used by producers against the recommendations made available.

Cost of labor

Cotton crop is a labor-intensive crop and labor cost is the major component of the total variable cost in cotton production under irrigated system. The labor cost of irrigated cotton production includes the cost of planting/sowing, weeding, irrigating, chemical spraying, picking as well as weighing and packing. These costs are grouped as manual operation costs. Almost all cotton producers in the study area used hired labor in performing these manual operation activities. The number of causal laborers employed determines the number of days taken to complete a particular activity. While cotton has a growing span of 6 to 7 months, causal laborers are employed for a maximum number of three months.

Among the manual operation costs, cost of picking took the greater share of both the total variable cost and the labor cost. Manual cotton picking is the common harvesting practice in the study area. Cotton farmers on irrigated fields pick twice with the first picking done after 65-70% of the bolls are open while the remaining cotton is harvested 15-21 days after the first harvest. The amount of money paid to causal laborer for cotton picking/harvesting varies but the standard rate prevailing in the study area is 1.20 birr/kg. The total cost of picking depends on the output of seed cottonseed cotton produced as the payment basis on kilograms picked/harvested. Accordingly, on average producers in the study area incurred Birr 2,956.10 per hectare.

The most commonly used irrigation practice in supplying water to the cotton field in the study area is open-channel irrigation using either the siphon or the furrow. In the Middle Awash Valley, cotton is irrigated for about five to six times depending on the availability of rain during the cropping period. The mean cost of labor for irrigating cotton was 1267 Birr/ ha. Weed management is the other pertinent practice in the production process of cotton. In the study area, producers use pre-plant irrigation as early weed management strategy. Starting from 20 days after plant-emergence to harvesting, most of the farmers weed at least three to four times in order to facilitate irrigation-water movement. The average cost of labor for weeding activities was found to be 1,100 Birr/ha.

Chemical spraying, planting/sowing, weighing, and packing were another labor demanding operations in cotton production. Cotton producers on average incurred 975 for chemical spraying Birr/ha. The average costs of planting/sowing and weighing were 458 and Birr 121 Birr/ha, respectively.

Other costs

Other costs of irrigated cotton production included the cost of rental value of land. Land is one of the major factors constraining cotton production in Amibara district. Land in the district is largely owned by clans (communal) and few private individuals. Leasing of land is the most commonly observed phenomenon in the study area. Therefore, most of the cotton farmers produce cotton either on rented land or as sharecropper. This cost is calculated only for the cropping season (six months) of the cotton crop. The rental value of land varies with the nature and type of the farmland. However, the average rental value of land for cotton production was about 3,100 Birr per hectare for the cropping season in the study area.

Profitability

To determine the market value of seed cotton, a gross margin analysis was conducted. Cross-sectional data on variable costs per hectare associated with production of seed cotton and the revenue generated from the sale was used. Gross margin was used as a proxy for profitability of an enterprise. Gross margin is gross output (price multiplied by yield) less variable / direct costs or the difference between income and variable costs.

To compute the gross income (total revenue), output (seed cotton) in kg/ha for each household was multiplied by the price at which a household sold the seed cotton at the farm gate. All variable costs per hectare associated with seed cotton production were identified (Table 3). The gross margin was then computed as the difference between the total revenue and the total variable costs.

Table 4 shows a summary of the mean revenue and gross margins in Birr per hectare (Birr/ha) for irrigated cotton production in the study area. In the table, the minimum and maximum values of each particular was also presented to compare and observe the differences (range).

Table 4: Returns and gross margin of irrigated cotton production

Variable	Mean	SD	Minimum	Maximum
Yield of seed cotton (kg/ ha)	2,463.4	521.54	1800	3800
Price of seed cotton (Birr/ kg)	12.53	1.09	10.00	15.00
Gross income (Birr/ ha)	30,866.4	6,118.06	20,900.00	45,600.00
Total variable cost (Birr/ ha)	20,572.17	1,899.06	17,113.00	25,074.33
Gross margin (Birr/ ha)	10,294.23	6040.37	482.00	23,091.00
Profit margin (%)	33.35			
Benefit to cost ratio	1.49			

Source: Own computation, 2016

At the computed cost of production (Birr 20,572.17/ha), average price of seed cotton (Birr 12.53/kg) and quantity of seed cotton produced per hectare (2463.4kg/ha), cotton producers experienced positive gross margin (Table 4) in the study area. The result further revealed that returns on Birr invested was Birr 1.49 in cotton production. This shows that a producer gains one birr and seventy-nine cents in every Birr invested in irrigated cotton production showing that the cotton business under irrigated condition

is a profitable venture in the study area and so farmers in the study area should be advised to venture into because it is profitable enterprise. This finding is in conformity with the results of Alam *et al*., (2013).

Break-even analysis (BEA)

To determine the price at which growers dedicate land and/or capital to cotton production, it is necessary to analyze the costs of growing cotton. However, cotton production costs provide only the first, albeit very important, step in determining the cotton prices necessary for growers to continue to produce cotton. Subject to rotational and other agronomic constraints, growers typically choose to grow the most profitable crop available in the region. This means that, where growers have genuine alternatives to cotton (and this is true in all the featured regions), it is necessary to look beyond the costs of growing cotton and to assess also the costs and profitability of alternative crops, so as to determine the opportunity cost of land to producers.

This approach is adopted because growers will need to receive a cotton price that covers the costs of producing cotton and compensates them for the profit that they would have earned had they grown the next best alternative crop. The profit-equalizing cotton price indicates this particular threshold level of the cotton price. This analysis determines the break-even price and the break-even yield at which the cotton enterprise remains in production process by covering the total costs incurred.

The break-even price was calculated as the ratio of total cost to total production (yield) while the break-even yield was taken as the ratio of total cost to sale price. Table 4 describes the break-even price and break-even yield to cover the total cost incurred in the production of irrigated cotton.

Table 5: Results of break-even analysis

Particular	Value
Total cost (Birr/ha)	20,572.17
Seed cotton yield (kg/ha)	2463.4
Unit price (Birr/kg)	12.53
Break-even price (Birr/kg)	8.35
Break-even yield (kg/ha)	1641.83

Source: Own computation

The results of the analysis showed that the break-even price that can cover the total cost under the current condition of production was about Birr 8 per kilogram. This shows that producers will continue in cotton production by covering the total cost if the price of a kilogram of seed cotton reaches seven birr. On the other hand, the break-even yield to cover the total cost was about 1642 kilogram per hectare. Therefore, cotton production under irrigated condition can cover total cost at the production level of 1642 kg/ha as it covers total cost of production. By producing this quantity of seed cotton, the farmer should face no profit no loss situation.

Sensitivity analysis of irrigated cotton production

The speed with which producers switch between crops depends on the gross margin, which is a function of prices and costs. The profitability analysis of irrigated cotton production is based on the prices and costs that faced the producers on planting in 2016. Over time prices, costs and yield of seed cotton change. Changes in prices, costs and yields obtained would push gross margins either in favor or against of cotton producers. Sensitivity analysis is therefore; test the robustness of smallholder profitability indicators to changes in key variable parameters.

A number of variables were assumed to change over time. Changes in real wages as labor is usually the largest component of total production cost and changes in material input prices due to different reasons necessitate testing the sensitivity of the profitability of irrigated cotton with respect to total variable costs. The changes in price of the seed cotton at the farm gate market and the average yield obtained by producers are another risky variable that undergone sensitivity tests. To assess changes to gross margins that occur as prices, costs and yields change, sensitivity analysis was carried out by changing total variable costs, output prices and yield obtained relative to the actual results. In this case, a change of ±25% in total variable costs, output prices and seed cotton yield was considered.

Table 5 shows changes in gross margins (profits) to changes in variable costs, output prices, and yields of seed cotton. This analysis has been done to know how much irrigated cotton producers have been satisfied in the range of costs, prices and yield. The results of the analysis show that irrigated cotton production was likely to be more sensitive to prices and yields than total variable costs. A reduction in total variable costs by 25% increases the profitability by 17%, while a similar decrease in prices and yield decrease the profitability by 22%. An increase in total variable costs by 25% reduced the profitability by 16.66%, while a similar increase in prices and yield of seed cotton increase the profitability by 13%.

Major production and marketing constraints of irrigated cotton

Producers were asked about problems being faced by them in the cultivation and marketing of irrigated cotton in the study area and results have been presented in Table 7 and 8, respectively. These constraints affect producers' productivity and profitability. The distribution of irrigated cotton growers according to constraints to production is presented in Table 7. It revealed that the most common constraints to irrigated cotton production in the study area were insect/pest infestation (100%), high cost of inputs (93%), soil salinity (87%), shortage of improved inputs (73%), shortage of land (67%) and inadequate extension service (57%) with their respective order of importance.

Table 6: Sensitivity analysis of the profitability of irrigated cotton production

Particular	Actual	±25% in total variable costs		±25% in unit price of seed cotton		±25% in yield of seed cotton	
		25% reduction in cost	25% increase in cost	25% reduction in price	25% increase in price	25% reduction in yield	25% increase in yield
Total variable cost (Birr/ ha)	20,572.17	15,429.13	25,715.21	20,572.17	20,572.17	20,572.17	20,572.17
Yield of seed cotton produced (kg/ ha)	2,463.4	2,463.4	2,463.4	2,463.4	2,463.4	1,847.55	3,079.25
Unit price of seed cotton (Birr/ kg)	12.53	12.53	12.53	9.4	15.66	12.53	12.53
Total revenue of seed cotton (Birr/ ha)	30,866.4	30,866.40	30,866.40	23,155.96	38,576.00	23,149.80	38,583.00
Gross margin (Profit)	10,294.63	15,437.27	5,151.19	2,583.79	18,004.83	2,577.63	18,010.83
Profit as % of total revenue	33.35	50	16.69	11.16	46.78	11.13	46.68
% change in gross margin		16.65	-16.66	-22.19	13.33	-22.22	13.33

Source: Own computation

Table 7: Distribution of respondents by production constraints (n=30)

Constraint	Frequency	Percentage	Rank
Lack of improved inputs/farming equipment	22	73.33	IV
Shortage of land	20	66.67	V
Insect/pest infestation	30	100	I
Soil salinity	26	86.67	III
High cost of inputs	28	93.33	II
Inadequate extension service	17	56.67	VI

Source: Field survey data, 2016

The distribution of irrigated cotton growers according to marketing constraints they have been faced with are presented in table 8 below. According to the result of the analysis of marketing constraints, a striking marketing constraint noticeable in the study area was shortage of capital reported by 87% of the respondents.

Table 8: Distribution of respondents by marketing constraints (n=30)

Constraint	Frequency	Percentage	Rank
Lack of market information	24	80.00	II
Shortage of capital	26	86.67	I
Low bargaining power	13	43.33	IV
Price risk	20	66.67	III

Source: Field survey data, 2016

Lack of market information (80%), price risk, or uncertainty (67%) and low bargaining power (43%) were among the major marketing constraints in the study area.

Conclusion and Recommendation

As an important commercial crop production and productivity are not only the criteria for development of cotton. Returns from this enterprise are then the major driving forces for the sustainability of the sub-sector for both smallholders and large-scale commercial producers. This study analyzed the profitability of small-scale irrigated cotton production in the Middle Awash Valley of Amibara district. The study was used data collected from 30 purposively selected respondents. The data were analyzed using the gross margin, break-even and sensitivity analysis framework.

Results of the cost structure showed that the major costs of irrigated cotton production are material costs, manual operational costs, and machinery operational costs. Similarly, results of break-up of production costs revealed that the share of manual operational costs (hired human labor) had occupied the prominent position of the total variable costs of irrigated cotton cultivation in the study area. The study also showed that the cost of chemicals (of different types) and the cost of picking (harvesting) were the largest costs of material and manual operational costs, respectively.

The gross margin analysis results revealed that irrigated cotton production is a profitable venture in the study area despite high cost of production. The sensitivity analysis also showed that cotton profitability was highly responsive to price of output and yield than total variable costs. It can be managed by reducing the production costs and increasing yields per unit area.

Based on the findings of this study, it is recommended that smallholder irrigated cotton producers should be supported in accessing of improved inputs through advocating the use of updated and yield increasing technologies. This needs effective cotton development policy and strategy regarding the provision specific extension services for the crop. Government should play its role by stabilizing output prices with good and paternalists intensions. Besides, there is a need to improve the pricing system of cotton. Cotton farmers should also be encouraged to form groups (marketing cooperatives) to improve their market intelligence and to increase their bargaining power. Small-scale credit facilities need to be provided to smallholders to expand their farming and overcome the problem of farming equipment. Moreover, policies should be developed to enhance productivity and thereby profitability of irrigated cotton farmers through the provision of extensive trainings and workshops on cotton production.

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